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An Input-Output Method for Long-Range Economic Projections

INPUT-OUTPUT (I–O) methods are being applied increasingly to the study of a variety of economic problems. These applications include measurement of the direct and indirect effects of stipulated changes in the output of one or more industries upon the outputs of all other industries; measurement of the effects on prices throughout the economy of changes in the costs or prices of one or more industries; assessment of markets for individual companies or industries, taking account of indirect demand that reaches the company or industry through a chain of interindustry repercussions; and calculation of industry outputs consistent with specified levels of gross national product (GNP).

An important use of the last-mentioned application is in studies of long-range economic problems. Typically, such studies require projections of industry outputs under alternative assumptions about the rate and pattern of economic growth. The use of I–O methods for long-term projections involves more comprehensive methodologies than the other types of use. It requires (1) projection of GNP, (2) conversion of the projection into the form and detail of the I–O table, and (3) the calculation of industry outputs.

The methods necessary to carry out this procedure are not set. They can be formulated in different ways, making widely different claims on the time, resources, and skills of those who design them and those who use them. This article describes one possible method. This method is fairly simple and its application does not require large resources. The article evaluates the adequacy of the method by comparing projected outputs with actual outputs, and examines the causes of error in order to identify the elements of the method whose refinement is most likely to improve the results.[1]

Because this report evaluates the method by comparing projected industry outputs with actual outputs, the projections must be for a past rather than a future year. 1968 was chosen because at the time the underlying research was undertaken it was the latest year for which actual industry output information was available. The projections for 1968 were made from the vantage point of the year 1963, chosen because it was the year in which the 1958 I–O table became available.[2]

Methodology

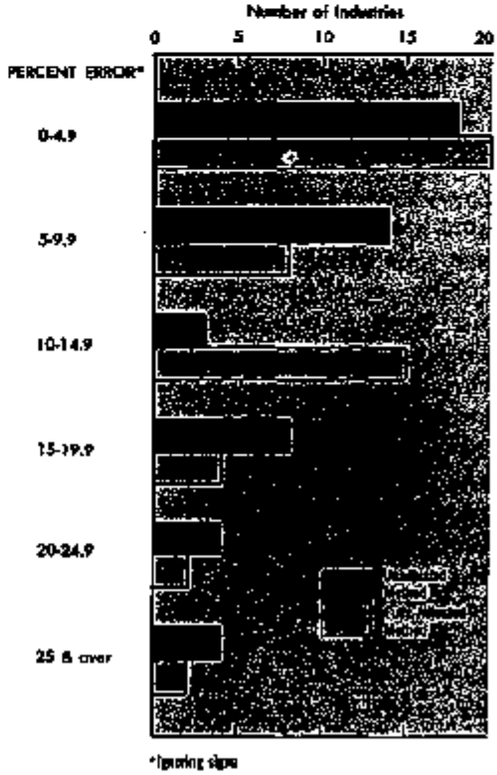
The use of I–O techniques to make long-range projections requires auxiliary tools and supplementary information not contained in the typical I–O tables.[3] These requirements correspond to the three stages of the procedure used for this study. The first stage is to derive projections of GNP and its major components. The second is to express them in the industry detail and in the prices and valuation level of the I–O table. The third is to use an inverse I–O matrix to derive projections of total output of each I–O industry. The three stages of the procedure will be discussed in turn.

Projecting GNP components

The first requirement for making 1968 industry output projections was to project GNP and its major components five years ahead. For this purpose, an

CHART 3

Frequency Distribution of Percent Error in Projections of 1968 Industry Outputs



*Ignoring signs

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1. The article is part of the Federal Government's Interagency Growth Study Project. Guidance for this research program is provided by an interagency steering committee consisting of representatives of the Office of Business Economics (OBE), the Bureau of Labor Statistics (BLS), the Office of Management and Budget, and the Council of Economic Advisers. The committee is chaired by a member of the council. Industry output projections for 1970 and 1980 have been published by BLS; see *Projections 1970*, BLS Bulletin No. 1536, December 1966, U.S. Government Printing Office, and *Patterns of U.S. Economic Growth*, BLS Bulletin No. 1672, 1970, U.S. Government Printing Office.

2. Although the table was not published until November 1964, preliminary estimates were available in 1963.

3. For an explanation of the 1958 and 1963 I–O tables prepared by OBE and a brief account of I–O techniques, see the November 1964, September 1965, and November 1969 issues of the SURVEY OF CURRENT BUSINESS.

econometric model developed for OBE by Lester C. Thurow was used.[4] This model, which is still in the formative stage, is designed to provide long-range projections of the U.S. economy and to aid in the formulation of fiscal policies that would achieve given unemployment targets.

Briefly stated, the model consists of 29 functional equations and five identities. The major exogenous variables are population, the unemployment rate, exports, prices, and variables that are instruments of Federal Government policy (e.g., tax rates, employee compensation and other purchases of goods and services, transfer payments, and grants-in-aid to State and local governments).

The model has a supply side and a demand side which are linked by a set of income flows. The supply and demand sides are estimated in constant dollars. Incomes are estimated in current dollars. Exogenous prices are used to move from one side of the model to the other.

Because both the unemployment rate and Government purchases are exogenous, the supply and demand sides need not balance. A gap between GNP estimated from the supply side and GNP estimated from the demand side indicates that the target unemployment rate cannot be achieved unless Government policies are changed.

The supply side of the model is used to estimate the GNP associated with a given unemployment target. Its equations determine the size of the labor force, its division between private and public employment, average annual man-hours, and gross capital stock. These labor input and capital stock variables are combined in a production function which yields the supply-side estimate of GNP.

A set of incomes is associated with the supply-side GNP. Total income necessarily equals the supply-side GNP, but its distribution among persons, corporations, and government is influenced by fiscal policies. The income equations of the model include numerous fiscal policy variables which are used to derive the distribution of total income.

Given the income flows, the demand equations estimate personal consumption expenditures, residential investment, business investment in nonresidential structures, equipment, and inventories, imports, and State and local government purchases. Exports are estimated exogenously because they depend primarily on foreign economic conditions. Federal Government purchases of business products (goods and services except employee compensation), the remaining element of final demand, are also exogenous. As an alternative, however, they can be determined residually by subtracting all other demand components of the GNP from total GNP as estimated from the supply side. In this study, the Government component was derived in this residual fashion.

The model was used to generate 1968 GNP and its major final demand components using actual values for the exogenous variables. The use of forecasts of these variables would have tested not only the errors generated by the model but also those stemming from inadequacies in the predictive powers of the forecaster. All endogenous variables, lagged and current, were generated by the model.

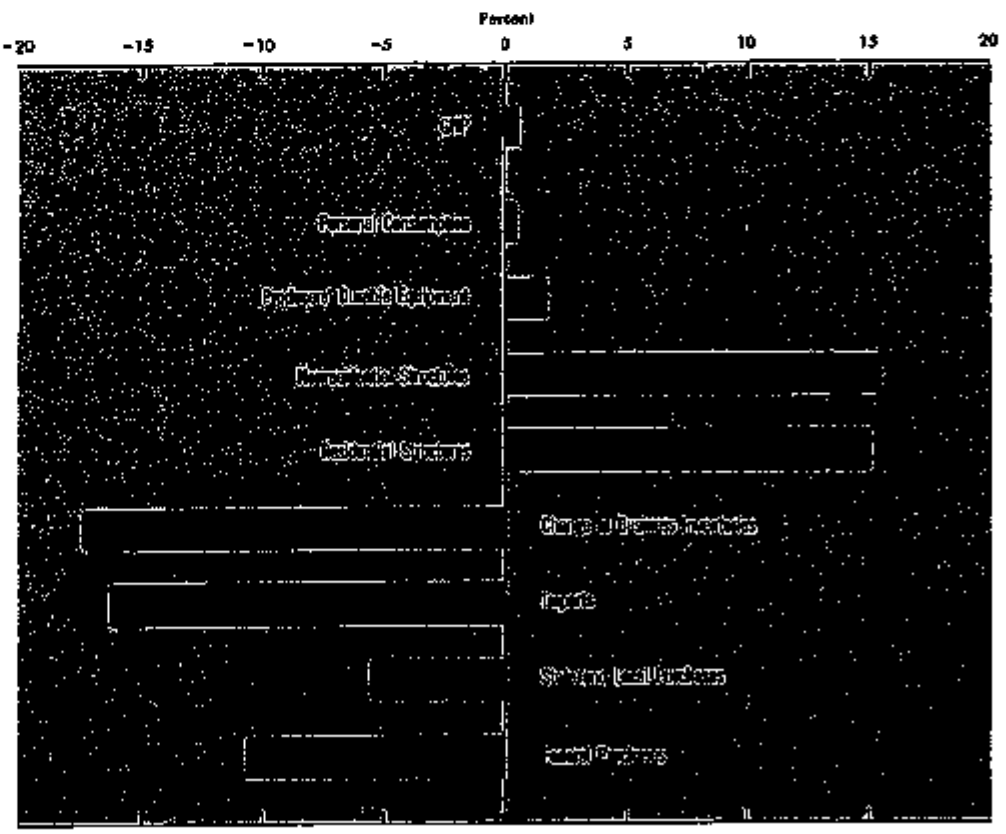
Projecting GNP components by I–O industry

Next, the demand components of GNP were translated into a "bill of goods," that is, the industry detail, prices, and valuation level used in the I–O table. The model distinguishes only broad GNP components and thus the construction of a bill of goods was a critical step. For example, the model provided only a global projection of personal consumption expenditures; it did not tell how these expenditures were divided among food, clothing, shelter, recreation, etc., nor among the various industries that produce these items. The calculation of this detail was part of the construction of the bill of goods.

The 1958 industry composition of GNP components is given in the final demand columns of the 1958 I–O table. They show, for each component of GNP, the dollar values contributed by each of the industries that make up the

CHART 4

Error in Projections of 1969 GNP and Its Components



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4. Lester C. Thurow, "A Fiscal Policy Model of the United States," SURVEY OF CURRENT BUSINESS, June 1969.

economy. The percentage distribution of the entries in each final demand column of the 1958 table was applied to the 1968 projection of the appropriate demand component of GNP, to derive the projections of 1968 final demand by I–O industry. These percentage distributions are termed "bridge tables." [6]

The bridge tables also served to translate the projected GNP components, which are expressed in purchasers' prices, into producers' prices, the valuation level used in the I–O table. They did so because the entries in the I–O table, from which the bridge tables were derived, are at producers' prices. The trade and transportation costs which constitute the difference between producers' and purchasers' prices appear in the I–O table as separate inputs from the trade and transportation rows to the final demand columns that show the purchase of goods with which these distribution services are associated.

The derivation of a 1968 bill of goods by the procedure just described assumes that over the 1958–68 decade there occurred no marked change in the industry composition of any of the GNP demand components that are distinguished by the model. For example, the procedure assumes that in 1968, as in 1958, 4.1 percent of total business outlays for equipment would be accounted for by office, computing, and accounting machines. Even a hasty look at production statistics for this industry casts doubt on this assumption. Likewise, the procedure allocates 2.5 percent of personal consumption expenditures to petroleum products—the same as in 1958, notwithstanding the disproportionate growth in the number of passenger cars.

In spite of the possible obsoleteness of the bridge tables, lack of annual data on the detailed industry composition of GNP components precludes low cost alternatives.[8] However, in projecting the industry composition of GNP components for 1968, it is possible to make use of bridge tables for 1947 as well as for 1958.[7] As can be seen from Appendix Table 1, the 1947 bridge tables differ markedly from the 1958 tables. Although it is questionable whether the differences between the 1947 and 1958 tables can be regarded as representing only trends, it was decided to utilize these differences to develop an alternative procedure for deriving the 1968 bill of goods. In this alternative procedure, the 1958 bridge tables were modified to reflect continuation to 1968 of the 1947–58 average annual rate of change in these bridge table entries.[8] (See the "projected 1968" bridge tables in Appendix Table 1.)

Projecting industry outputs

The final step in the procedure was to multiply the two alternative 1968 bills of goods by an I–O inverse (total requirements) matrix to derive the total outputs required from each industry to supply the bills of goods. The entries in such a matrix measure the output required directly and indirectly from each of the industries to produce one dollar of final output of any industry that is specified.[9] The inverse matrix used reflected 1958 input coefficients, i.e., the proportions in which the various industries contributed to the output of any given industry in 1958. Ideally, this matrix should incorporate 1968 coefficients, which might be very different from those that existed in 1958.

Input coefficients change for many reasons. The introduction of new products and the disappearance of existing ones, changes in the manner in which products are produced, and changes in the relative importance of various products all can lead to changes in these coefficients.

Technological progress is an important cause of coefficient change. Changes in the scale of production, including utilization of existing capacity as well as long-term extensions or curtailments in the scale of operations which occur in response to changes in supply and demand, can also alter coefficients. So can substitutions, induced by changes in supply and demand, that are made among intermediate products, labor, and capital. Even if coefficients for given products remain the same, changes in the proportions in which the given products are produced, including changes in their geographical origin, can affect the coefficients, because these coefficients are in effect weighted averages that reflect the product mix of the industries specified in the I–O tables.

It is difficult to make a systematic and exhaustive list of the "real" factors that can cause changes in coefficients. For instance, Government regulation, not hitherto mentioned, is probably a significant source of change. In addition, there are factors stemming from statistical procedures, such as those related to conventions used in handling secondary products and imports in the construction of I–O tables, and the statistical errors to which these tables are subject.

The foregoing suggests that the projection of coefficient change is a difficult task. Empirical work done at OBE has confirmed this suggestion. Comparison of coefficients for the years 1947 and 1958 [10] revealed many changes. They ranged from a decrease of 95 percent in the input coefficient of coal into the transportation industry, to an

6. Because the model expressed the GNP components in 1958 prices, i.e., the prices of the I–O table, the 1958 bridge tables could be applied directly to the projected GNP components. If the model's projections had been expressed in the prices of some other year, it would have been necessary first to convert them into 1958 prices before applying the bridge tables.

6. The BLS projections for 1970 and 1980, to which reference has been made, were based on more refined assumptions. For example, the projections of personal consumption expenditures were based on regression analyses which relate per capita consumer expenditures for about 80 categories to total consumption, both current and lagged, lagged consumption for the particular expenditure category, and relative prices. See Hendrik Houthakker and Lester D. Taylor, *Consumer Demand in the United States, 1929–1970*, Cambridge, 1966.

7. The 1947 bridge tables were derived from 1947 I–O tables compiled by BLS. These tables were reworked by OBE to make them conceptually and statistically consistent with the 1958 tables and revalued to reflect 1958 producers' prices.

8. Modifications were made only for industries which accounted for at least 0.5 percent of a given final demand category in 1947 and for which the 1947–58 trend was at least 0.01 percent per year. Because of noncomparabilities between the 1947 and 1958 I–O tables, it was necessary to combine I–O industries 16, 17 and 19; 24 and 25; 56 and 57; and 13 and 60, and to eliminate 62 from the 1958 final demand column. The trend-adjusted percentage distributions were forced to add to 100 percent.

9. An inverse derived from a domestic base table was used. In such a table the domestic port values of transferred imports are shown as a negative final demand column. In a total base table these imports are shown as a row. A domestic base inverse was used mainly because the 1968 industry outputs with which the projected outputs were compared represented domestic rather than total outputs.

10. Beatrice N. Vaccara, "Changes Over Time in Input-Output Coefficients for the United States," *Applications of Input-Output Analysis*, Volume 2, Amsterdam, 1970; and Beatrice N. Vaccara, *Changes Over Time in U.S. Input-Output Relationships*, U.S. Department of Commerce, Office of Business Economics, July 1969 (mimeographed).

increase of 218 percent in the input coefficient of rubber and miscellaneous plastic products into the household furniture industry. Not all cases were so extreme, but coefficients changed markedly, both in degree and direction, on a broad front.

It was evident that without an extensive analysis of the causes of coefficient change, it would be impossible to construct a matrix incorporating projections of individual coefficients to 1968.[11] Consequently, a decision was made to use, as a first approximation, the 1958 inverse matrix without modification. Reliance was placed on the often expressed proposition that in an industrial economy as large and long-established as that of the United States, changes in the coefficients for entire industries tend to occur slowly. For example, introduction of superior production processes does not affect the entire industry simultaneously, because existing capacity in good working order is rarely scrapped immediately. Rather, these processes spread gradually, as industrial capacity is extended or as aging capacity is discarded at a somewhat faster rate. For example, at the end of 1968, only 37 percent of U.S. steel-making capacity relied upon the basic oxygen furnace, although this furnace was perfected by 1954.[12]

It appeared likely, however, that use of the 1958 inverse matrix would lead to substantial errors, and an alternative technique, designed to allow for coefficient change, was tried. Comparison of the 1947 and 1958 coefficients revealed that consumption of a given input per unit of output tended to change in the same direction for all the using industries. For example, almost all the coefficients along the iron and steel industry row of the direct requirements matrix showed decreases between 1947 and 1958. There were substantial variations in the rate of decrease, however: use of iron and steel products per dollar of new construction declined 18 percent, whereas the use of such products per dollar of aircraft and ordnance production declined 62 percent. Moreover, not all the rows showed patterns as systematic as that for the iron and steel industry. In some rows, there were instances of coefficient change in the direction opposite to the average, and these opposite movements were not confined to the coefficients for small customers nor to producing industries with small average changes.

In spite of their imperfections, the row patterns seemed to suggest a summary adjustment for coefficient change. To derive this summary adjustment, the 1958 bill of goods was multiplied by the 1947 inverse; then 1958 intermediate outputs were derived by subtracting from each industry's total output, thus calculated, the industry's 1958 final demand. The actual 1958 industry intermediate outputs were expressed as percentages of the derived intermediate outputs. These percentages measured the errors in intermediate outputs which stemmed from the failure to take into account changes in coefficients from 1947 to 1958.

Ignoring signs and without weighting, the 71 producing industries examined showed an average difference of 30 percent between the intermediate output actually required to produce the 1958 bill of goods and the intermediate output derived by using the 1947 inverse. When annual rates of change, rather than total change over the period, were computed for the 71 industries, the average (without regard to sign) was 2.3 percent per year. The annual rates of change for individual industries varied considerably. Some industries, for instance petroleum refining and electric wiring and lighting equipment, showed virtually no change. Office, computing, and accounting machines showed an increase of 15.2 percent per year. Coal mining registered a decrease of 5.5 percent. Of the 71 industries examined, 28 had average annual changes in intermediate output of 2 percent or more, 12 negative and 16 positive.

It was decided to adjust for the impact of coefficient changes in only a limited number of industries. Adjustments were made only for industries that showed changes in the intermediate output requirement of at least 2.0 percent per year. For example, the average annual increase of 15.2 percent noted above for the office, computing, and accounting machines industry was assumed to continue for 10 years; therefore, the 1968 intermediate output for this industry derived by using the 1958 inverse was multiplied by 4.1. (See Appendix Table 2.)

Summary of Estimating Procedure

It may be worthwhile to summarize the steps taken to project 1968 outputs by I–O industry. First, projections of 1968 GNP and its major components (in 1958 prices) were derived by use of the model. Second, these final demand components were allocated among the industries shown in the 1958 I–O table by use of two alternative sets of bridge tables; a set using actual 1958 data and a set that allowed for a continuation to 1968 of the 1947–58 average annual rates of change in the table entries. Third, the two 1968 bills of goods resulting from the application of the bridge tables were multiplied by the 1958 inverse matrix to yield estimates of total 1968 output by I–O industry. In addition, for selected industries, intermediate output (total output less final demand) derived from this calculation was adjusted to allow for a continuation of the 1947–1958 impact of coefficient change.[13]

The four alternative projections of

11. The 1970 and 1980 BLS projections of industry output were based on detailed projections of 1970 and 1980 input coefficients utilizing information on past and expected developments. See *1970 Input-Output Coefficients*, U.S. Department of Labor, BLS Report No. 326, September 1967, and *Patterns of U.S. Economic Growth*, BLS Bulletin No. 1672, 1970.

12. *Steel Facts*, December-January 1969.

13. The procedure actually used was somewhat more complicated. The 3-step procedure summarized above was used to derive preliminary projections of industry outputs for both 1963 and 1968. The indicated 1963–68 percentage changes were then applied to actual 1963 outputs to yield the final projections of 1968 industry outputs. This procedure, which permitted utilization of the latest available information on output by I–O industry, resulted in somewhat better 1968 projections than a procedure which used the 1958 inverse matrix to determine 1968 outputs directly. The 1963 data on output by I–O industry were prepared as part of OBE's continuing I–O work.

It should be noted that in the year 1963, the vantage point from which the projections in this article were made, the latest industry output data that could have been prepared would have been for the year 1962 rather than 1963. The preparation of such data for 1962 would have required considerable additional effort. It was decided not to expend this effort because the 1968 projections would not have differed significantly if percentage changes had been computed from 1962 rather than from 1963.

1968 industry outputs were compared with estimates of actual 1968 outputs and the percentage differences between projected and actual outputs were computed. Because of incomplete information about actual 1968 outputs, the comparison of projected and actual outputs was confined to manufacturing, mining, agriculture, and trade. In some cases, it was necessary to combine industry output projections to make them comparable to the estimates of actual outputs; in all, comparisons for 51 industry groups were made.

Evaluation of 1968 Projections

DIFFERENCES between projected and actual 1968 industry outputs can result from deficiencies (1) in the model used to project the GNP components, (2) in the bridge tables used to convert these components into bills of goods, and/or (3) in the techniques for deriving industry outputs corresponding to given bills of goods. In addition, some of the differences between projected and actual outputs may result from errors in the "actual" 1968 outputs, which are subject to error because of deficiences in the source data on which they rely. Particular difficulties were encountered in matching available actual data with I–O industry definitions and in converting the 1968 value of shipments into 1958 prices.

Effectiveness of methodological refinements

The actual 1968 outputs, the four alternative projected outputs, and the percentage differences between projected and actual outputs for the 51 industries studied are shown in table 1. For each alternative, average errors for the 51 industries are also shown. These averages were computed without regard to sign, and on an unweighted basis as well as with industry outputs as weights.

The weighted average error in the 1968 projections based on the use of the 1958 bridge tables and the 1958 inverse was 10.3 percent. The joint effect of the methodological refinements in the bridge tables and in the use of the 1958 matrix reduced this error 2.5 percentage points, to 7.8 percent. On an unweighted basis, the corresponding figures were 10.6 percent, 1.5 percentage points, and 9.1 percent. Thus, introduction of the refinements had a much larger impact in reducing the weighted than the unweighted error. In other words, the size of the improvements stemming from the refinements was correlated positively with industry size.

The array of average errors can be used to gauge the separate contributions of the two methodological refinements. The contribution of the bridge table refinement can be assessed in two ways: by calculating the error reduction due to its introduction into the projections that use the 1958 inverse matrix without modification, or into the projections that use the 1958 inverse with adjustment for coefficient change. Similarly, there are two ways of measuring the effect of introducing the refined use of the 1958 inverse: by calculating the error reduction due to its introduction into the projections that use the 1958 bridge tables, or into the projections that use the adjusted bridge tables. In table 2, the average errors calculated in table 1 are arrayed and differenced to derive the separate contributions of the two methodological refinements.[14]

As can be seen from table 2, the weighted error measure indicates that the bridge table refinement was a more important source of improvement than the refinement in the use of the 1958 inverse: 1.8 as compared with 1.4 percentage points, or 1.1 as compared with 0.7 percentage points, depending on the variant chosen

The unweighted error measure conveys the opposite message One pair of comparisons suggests that the refinement in the use of the 1958 inverse contributed 1.8 percentage points to the improvement, as compared with 0.6 percentage points contributed by the bridge table refinement. The other pair suggests that the refinement in the use of the 1958 inverse contributed 0.9 percentage points, whereas the bridge table refinement actually increased the error by 0.3 percentage points.

It can be seen that the magnitude of the improvement attributable to the refinement in the use of the 1958 inverse is of the same order of magnitude in the weighted and the unweighted error calculations. It is the contribution of the bridge table refinement that shrinks if we substitute unweighted for weighted error measures. This suggests that the size of the improvements stemming from the bridge table refinement was strongly correlated with industry size.

The difference in the impact of the two refinements may be related to the fact that the criterion for the introduction of the adjustment for coefficient change was much stricter than that for the introduction of the bridge table refinement. Projected 1968 intermediate outputs were adjusted for coefficient change only in industries in which the 1947–58 change in intermediate output requirements was 2 percent or more per year. Adjustments to the 1958 bridge table percentages were made whenever the 1947–58 trend was 0.01 percent or more per year.

In spite of the general improvement due to the methodological refinements, the I–O method, as applied, resulted in sizable errors in the projections of industry outputs (Chart 3, p. 47). For 23 of the 51 industries the error was 10 percent or more. For four industries—tobacco manufacturers, wooden containers, rubber and miscellaneous plastics products, and optical, ophthalmic,

14. Readers should note two characteristics of this "factoring" technique. First, the two measures of the contribution of a given refinement differ. Second, when properly paired, the separate contributions of the two refinements do not equal the total change in the projection error.

Table 1.—Comparison of Actual and Projected 1968 Industry Outputs

I-O industry number and title		Actual output (millions of 1968 dollars)	Projected outputs (millions of 1968 dollars)				Percent error in projected outputs			
			1958 bridge tables		Refined bridge tables		1958 bridge tables		Refined bridge tables	
			1958 inverse matrix	Refined use of matrix*	1958 inverse matrix	Refined use of matrix*	1958 inverse matrix	Refined use of matrix*	1958 inverse matrix	Refined use of matrix
		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
1	Livestock and livestock products	31,373	38,044	38,044	35,475	35,475	21.3	21.3	13.1	13.1
2	Other agricultural products	26,904	32,502	32,502	30,218	30,218	20.8	20.8	12.3	12.3
5, 6	Metal mining	2,335	2,624	2,625	2,601	2,601	12.4	12.4	11.4	11.4
7	Coal mining	3,338	3,856	*3,233*	3,692	*3,001*	15.5	-3.1	10.6	-10.1
8	Crude petroleum and natural gas	12,786	13,922	13,922	14,358	14,358	8.9	8.9	12.3	12.3
9, 10	Mining of nonmetallic minerals (exc. fuels)	2,885	3,017	3,017	3,004	3,004	4.6	4.6	4.1	4.1
11	New construction	66,242	76,250	76,250	75,697	75,697	15.1	15.1	14.3	14.3
12	Maintenance and repair construction	21,367	26,168	*23,620*	25,654	*21,884*	22.5	11.1	20.1	2.5
14	Food and kindred products	88,006	94,722	94,722	88,300	88,300	7.6	7.6	.3	.3
15	Tobacco manufactures	7,070	9,256	*9,054*	8,707	*8,498*	30.9	27.9	23.2	20.1
16, 17, 18, 19	Textile mill products and apparel	47,002	47,107	*47,777*	43,098	*43,727*	.2	1.6	-8.3	-7.0
20	Lumber and wood products, exc. containers	11,501	12,475	12,475	12,134	12,134	8.5	8.5	5.5	5.5
21	Wooden containers	578	*544*	*420*	520	*400*	-5.9	-27.3	-10.0	-30.8
22	Household furniture	5,002	5,036	5,036	4,758	4,758	.7	.7	-4.9	-4.9
23	Other furniture and fixtures	2,468	2,731	*2,683*	2,772	*2,725*	10.7	8.7	12.3	10.4
24	Paper and allied products, except containers and boxes	16,593	15,539	15,539	15,616	15,616	-6.4	-6.4	-5.9	-5.9
25	Paperboard containers and boxes	6,780	6,122	6,122	6,074	6,074	-9.8	-9.8	-10.5	-10.5
26	Printing and publishing	20,489	19,294	19,294	18,585	18,585	-5.7	-5.7	-9.3	-9.3
27, 28	Chemicals, plastics and synthetic materials	36,648	31,161	*37,135*	30,281	*36,089*	-15.0	1.3	-17.4	-1.5
29	Drugs, cleaning and toilet preparations	12,799	12,081	*13,029*	13,396	*14,232*	-5.6	1.8	4.7	11.2
30	Paints and allied products	3,186	3,222	3,222	3,099	3,099	1.1	1.1	-2.7	-2.7
31	Petroleum refining and related industries	27,190	27,845	27,845	28,569	28,569	2.4	2.4	5.1	5.1
32	Rubber and miscellaneous plastics products	17,303	13,889	13,889	13,285	13,285	-19.7	-19.7	-23.2	-23.2
33, 34	Leather and leather products	4,675	5,106	5,106	4,320	4,320	9.2	9.2	-7.6	-7.6
35, 36	Stone, clay and glass products	14,621	15,760	15,760	15,455	15,455	7.8	7.8	5.7	5.7
37	Primary iron and steel manufacturing	30,746	31,763	*27,794*	30,887	*26,879*	3.3	-9.6	.5	-12.6
38	Primary nonferrous metals manufacturing	15,739	15,700	15,700	15,904	15,904	-.2	-.2	1.0	1.0
39	Metal containers	3,126	3,057	3,057	2,920	2,920	-2.2	-2.2	-6.6	-6.6
40	Heating, plumbing and fabricated structural metal products	12,728	12,266	12,266	12,571	12,571	-3.6	-3.6	-1.2	-1.2
41, 42	Screw machine products, metal stampings and other fabricated metal products	18,639	17,201	*16,645*	16,999	*16,419*	-7.7	-10.7	-8.8	-11.9
43	Engines and turbines	4,088	3,426	3,426	3,961	3,961	-16.2	-16.2	-3.1	-3.1
44	Farm machinery and equipment	3,857	4,068	4,068	4,024	4,024	5.5	5.5	4.3	4.3
45, 46	Construction, mining and materials handling machinery	6,948	7,607	7,607	7,130	7,130	9.5	9.5	2.6	2.6
47	Metalworking machinery and equipment	6,201	6,442	6,442	6,174	6,174	3.9	3.9	-.4	-.4
48	Special industry machinery and equipment	4,864	4,942	4,942	4,206	4,206	1.6	1.6	-13.5	-13.5
49	General industrial machinery and equipment	7,282	7,338	7,338	7,050	7,050	.8	.8	-3.2	-3.2
50	Machine shop products	3,763	2,882	*3,934*	3,068	*4,158*	-23.4	4.6	-18.4	10.5
51	Office, computing and accounting machines	10,854	5,490	*8,127*	6,298	*8,966*	-49.4	-25.2	-42.0	-17.4
52	Service industry machines	6,586	5,401	5,401	5,349	5,349	-17.9	-17.9	-18.8	-18.8
53	Electric transmission and distribution equipment and electrical industrial apparatus	9,766	9,564	*10,378*	9,281	*10,029*	-2.1	6.3	-5.0	2.7
54	Household appliances	7,312	6,796	*7,468*	6,288	*7,048*	-7.1	2.1	-14.0	-3.6
55	Electric lighting and wiring equipment	3,827	3,772	3,772	3,706	3,706	-1.4	-1.4	-3.2	-3.2
56, 57	Radio, television and communication equipment, electronic components	27,714	23,072	*28,716*	25,991	*31,688*	-16.7	3.6	-6.2	14.3
58	Miscellaneous electrical machinery, equipment and supplies	2,862	2,866	2,866	2,756	2,756	.1	.1	-3.7	-3.7
59	Motor vehicles and equipment	47,162	54,291	54,291	54,371	54,371	15.1	15.1	15.3	15.3
60, 13	Aircraft and ordnance	34,248	23,807	23,807	27,519	27,519	-30.4	-30.4	-19.6	-19.6
61	Other transportation equipment	6,540	6,515	6,515	5,695	5,695	-.4	-.4	-12.9	-12.9
62	Professional, scientific and controlling instruments and supplies	6,075	5,332	*5,831*	5,592	*6,095*	-12.2	-4.0	-7.9	.3
63	Optical, ophthalmic, and photographic equipment and supplies	4,556	3,006	*3,198*	2,852	*3,089*	-34.0	-29.8	-37.4	-32.2
64	Miscellaneous manufacturing	8,503	8,674	8,674	8,117	8,117	2.0	2.0	-4.6	-4.6
69	Wholesale and retail trade	146,882	150,729	150,722	147,150	147,150	2.6	2.6	.2	.2
							Error (ignoring signs)			
	Total	829,845	844,774	856,840	825,301	835,741	530.4	451.1	509.9	464.1
	Average:									
	Unweighted						10.4	8.8	10.0	9.1
	Weighted by output						10.3	8.9	8.5	7.8

*Values in italics indicate that the intermediate output of these industries was adjusted for coefficient change.

Source: U.S. Department of Commerce, Office of Business Economics.

and photographic equipment and supplies—the error was over 20 percent.

Sources of error in output projections

As has been stated, the errors in the 1968 industry output projections are due to errors in the GNP projections, in the bridge tables, and/or in the input coefficients. Unfortunately, it is not possible to isolate the error due to each of these factors. To do that would require the actual 1968 GNP components, the actual 1968 bridge tables, and the actual 1968 inverse matrix. Only the actual 1968 GNP components are known. The errors in the output projections that stem from errors in the GNP projection can be measured by substituting actual for projected GNP components in deriving industry output projections and comparing the errors in the new projections with the errors in the prior projections.

Substitution of actual for projected GNP components reduced the errors in the output projections only slightly. The weighted average error was reduced from 7.8 to 7.1 percent and the unweighted average from 9.1 to 8.8 percent. The small size of the improvement was due in part to the fact that the model performed well in projecting total GNP for 1968; it might not perform so well for other years.

Table 2.—Average Percentage Error in 1968 Industry Output Projections and Change Due to Refinements in 1958 Bridge Tables and in Use of 1958 Inverse Matrix

Method	1968 matrix	Refined use of matrix	Change due to refined matrix use
	Output-weighted error*		
1958 bridge	10.3	8.9	−1.4
Refined bridge	8.5	7.8	−.7
Change due to bridge refinement	−1.8	−1.1	
	Unweighted error*		
1958 bridge	10.6	8.8	−1.8
Refined bridge	10.0	9.1	−.8
Change due to bridge refinement	−.6	.3	

*Ignoring signs.

Source: U.S. Department of Commerce, Office of Business Economics.

The error in projecting 1968 GNP (in 1958 prices) was $3.7 billion, an overstatement of only one-half of one percent.[14] Personal consumption expenditures and producers' durable equipment were projected quite accurately but there were considerably larger errors in the remaining components (Chart 4, p. 48). New construction was overstated about 15 percent, and imports and State and local government purchases were seriously understated. Because the pluses and minuses were not fully offsetting, the residual estimate of Federal Government purchases was also in error.

For a few industries, the GNP projection was a substantial source of error. As might be expected, these were industries whose output was determined primarily by GNP components that were projected poorly. Construction is an outstanding example. Aircraft and ordnance is another. The output of this industry was understated 19.9 percent. This was attributable in large part to the fact that 78 percent of the total final demand for this industry represented sales to the Federal Government, a GNP component that was seriously understated. When actual 1968 values of GNP components were used, the output of this industry was understated only 7.1 percent.

It appears from the above analysis that the bulk of the error in the 1968 industry output projections is attributable to deficiencies (1) in the bridge tables used to translate GNP components into a bill of goods and (2) in the techniques involving the 1958 inverse matrix that were used to derive industry outputs from the bill of goods.[15] However, this assignment of responsibilities should not be applied out of context. If a model had been used that projected GNP components in greater detail, the error attributable to bridge tables would have been smaller. On the other hand, it is very probable that the contribution of model error would have been larger.[17]

Comparison with crude alternatives

Thus far, the techniques of projecting industry output discussed in this report have been evaluated without reference to alternative techniques. A comprehensive comparison of I–O techniques with alternative techniques is underway at OBE. Only one simple comparison will be made here with the GNP blow-up method, a frequently used method which assumes that all industry outputs will change in the same proportion as total GNP.

In 1963, the starting point for the 1968 projections, the full employment growth rate of the U.S. economy was estimated as 3.5 percent per year by the Council of Economic Advisers. The Council also estimated that the actual 1963 GNP (in 1958 prices) was $27 billion below potential GNP.[18] Application of the 3.5 percent growth rate to the 1963 potential GNP of $578 billion (in 1958 prices) yields a potential 1968 GNP of $636.2 billion, or 124.5 percent of actual 1963 GNP. The GNP blow-up method would thus project the 1968 output level for each industry at 124.5 percent of its actual 1963 value.

This method of projecting industry outputs results in higher average errors than the "refined" I–O method used in this study. The weighted and unweighted average errors for the GNP blow-up method were 10.1 and 12.2 percent, respectively, compared to 7.8 and 9.1 percent for the I–O method. The GNP blow-up method resulted in smaller errors for 16 industries. For 30 industries, the errors were larger; for 5 industries, they were virtually the same. The blow-up method resulted in errors of over 20 percent for 9 industries, as compared with 4 such industries

15. All exogenous variables were inserted into the model at their actual values in calculating the errors in forecasting 1968 GNP. Thus, the errors measure what in technical parlance is called "model" error. In making true projections, the exogenous variables are not known. Errors in the projections of these variables become an additional source of error.

16. This statement should be read in the context of the previously stated qualification that the "actual" outputs for 1968 are themselves subject to error.

17. Although the errors contributed by deficiencies in the bridge tables and in the input coefficients cannot be separated, an attempt was made to gain some insight into their relative importance. This was done by separating industries selling primarily to final demand from those selling primarily to other industries and those selling to both. Weighted as well as unweighted average errors for the three groups were compared. These comparisons however, did not shed light on the relative contributions of the bridge tables and coefficients to the errors.

18. *Economic Report of the President*, January 1964, p. 57.

APPENDIX Table 1.—I-O Bridge Tables for Major GNP

[Per

Industry number	Personal consumption expenditures			Producers' durable equipment			Nonresidential structures			Residential structures			Exports of goods and services		
	1947	1958	Projected 1968	1947	1958	Projected 1968	1947	1958	Projected 1968	1947	1958	Projected 1968	1947	1958	Projected 1968
1	3.00	0.78	0.55	0.06									0.88	0.16	0.16
2	1.79	.84	.40										5.92	7.73	7.79
3	.16	.10	.10										.20	.12	.15
4														.01	.01
5													.07	.17	.17
6													.22	.02	.02
7	.48	.09	.09										1.92	1.44	1.00
8	.03												.62	.12	.08
9	.07	.01	.01										.04	.18	.18
10													.19	.28	.22
11							94.90	98.40	98.40	98.50	98.10	98.10		.01	.01
12															
13*	.06	.05	.06	.01									.08	.07	.17
14	17.25	15.78	13.16										7.94	5.58	3.79
15	1.78	1.47	1.19										1.19	1.96	2.78
16*	.58	.23	.18	.01									2.88	.80	.33
17*	.29	.28	.19	.09	.18	.18							.48	.20	.07
18	3.93	3.56	3.42										.27	.60	.41
19*	.34	.88	.27										.29	.08	.45
20	.28	.05	.05	.13	.20	.02							.77	.47	.30
21				.08									.04	.01	.01
22	.80	.59	.70	.39	.50	.50							.12	.08	.08
23	.04	.04	.04	2.73	3.19	3.88							.09	.08	.08
24*	.15	.20	.20	.01									.71	1.11	1.40
25*	.10	.01	.01										.16	.08	.11
26	1.11	.84	.58										.48	.60	.49
27	.08	.07	.07										1.73	2.88	4.94
28													.41	1.46	1.44
29	.52	1.28	1.72										.51	1.38	2.09
30	.02	.01	.01										.19	.11	.12
31	1.40	2.50	3.64										2.78	2.70	2.79
32	.69	.46	.39	.05	.21	.21							1.08	.09	.74
33													.12	.12	.13
34	1.22	.90	.63	.09	.02	.02							.24	.15	.15
35	.12	.04	.04	.15									.46	.29	.29
36	.12	.07	.07										.58	.48	.31
37	.05	.01	.01										5.00	2.28	1.09
38	.05			.01									1.72	1.38	.98
39	.02			.17	.04	.04							.14	.11	.11
40	.13	.02	.02	1.67	2.69	4.17							.56	.90	1.40
41	.18	.09	.09	.02									.37	.12	.12
42	.19	.39	.13	.70	.58	.58							1.06	1.07	1.87
43	.02	.04	.04	.97	3.30	4.42							.90	.88	.79
44	.01			5.93	6.07	8.80							1.18	.80	.58
45				6.50	4.37	4.58							3.34	3.02	3.52
46				2.19	1.41	.88							.43	.82	.82
47	.04	.01	.01	4.97	4.61	3.90							1.49	1.41	1.28
48	.01	.08	.01	5.28	5.87	3.66							2.08	1.08	1.10
49	.01			4.48	4.20	3.64							.98	1.17	1.87
50	.02												.01	.06	.08
51	.02	.02	.02	3.35	4.66	4.19							.48	.58	.58
52		.09	.09	3.22	3.52	4.80							.57	.57	.57
53	.01	.01	.01	6.57	5.48	5.78							.97	1.23	1.30
54	.93	.83	.67	.07	.37	.39							.48	.80	.60
55	.16	.11	.11	.19	.10	.10							.42	.27	.27
56*	.88	.47	.47	2.94	4.03	4.58							.54	.98	1.31
57*	.11	.05	.06	.85	.11	.13							.21	.38	.58
58	.12	.09	.09	.91	.33	.83							.28	.38	.90
59	1.34	3.17	3.31	16.37	14.28	18.49							5.59	3.01	2.58
60*	.01	.01	.01	.97	1.48	1.88							.78	2.38	6.25
61	.28	.25	.25	6.10	4.71	3.48							1.38	1.27	.64
62	.31	.13	.13	1.42	2.13	2.88							.62	.78	.68
63	.12	.16	.16	.89	.65	.65							.39	.38	.33
64	1.06	.67	.67	.74	1.11	1.47							.70	.40	.33
65	4.31	3.99	1.98	2.53	2.06	1.51							14.00	9.85	6.64
66	.99	1.35	1.72	1.59	1.45	1.53							.14	.27	.27
67	.01													.04	.04
68	1.29	2.79	3.71											.14	.14
69	21.88	21.22	21.22	11.38	14.96	17.44							4.68	6.05	7.18
70	3.76	4.07	4.07										.46	.09	.09
71	10.40	12.78	15.91				1.70	1.20	1.20	4.59	5.80	5.88	.24	1.09	1.09
72	2.71	3.28	2.43												
73	1.19	.65	.36										.54	1.06	1.51
74															
75	1.38	1.51	1.55												
76	1.80	1.29	.65										.67	1.18	1.60
77	5.33	7.06	8.29	.96										.03	.09
78	.18	.22	.22										.04	.28	.28
79	.94	.11	.11											.01	.01
80	.61	1.88	2.45		.06	.06							.90	.33	.70
81															
82															
83				1.48	−.07	−.07	4.20	−.60	−.60		−3.40	−3.40	3.22	.89	.89
84															
85	−.46	−.40	−.40										8.86	17.12	17.12
86	1.68	1.21	1.22												
87															
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

*Projected to 1968 on the basis of average annual rate of change, 1947-58, for the following combinations of industries: 16, 17 & 19; 24 & 25; 56 & 57; 13 & 60.

NOTE.—Trend adjusted 1968 percentages scaled to force column totals to add to 100.00.

Components, 1947, 1958, and Projected 1968

cent]

Imports of goods and services 1947	Imports 1958	Imports Projected 1968	Federal Government purchases (other than compensation) 1947	Federal 1958	Federal Projected 1968	State and local government purchases (other than compensation) 1947	State and local 1958	State and local Projected 1968	Federal Government compensation 1947	Federal comp. 1958	Federal comp. Projected 1968	State and local government compensation 1947	State and local comp. 1958	State and local comp. Projected 1968	Industry number
1.81	1.40	.08	-.26	-0.01	-0.01	0.11	0.06	0.06							1
1.90	1.05	1.30	2.03	3.25	3.77	.22	.14	.14							2
3.17	1.42	.07	-.09	-.43	-.42	.05									3
			-.77	.14	.14		-.34	-.36							4
1.69	2.11	2.40													5
2.17	1.35	.64	-.04	.88	.59										6
.02	.05	.03	.42			1.48	.32	.08							7
8.22	5.55	8.12													8
1.78	.45	.30	.02	.02	.08		-.05	-.05							9
.10	.38	.38		.03	.03		.06	.06							10
			18.58	9.66	4.10	49.95	61.79	64.22	.27	1.01	1.01	.55	1.42	2.25	11
			3.94	1.97	.44	7.15	6.29	4.66	.65	2.18	6.00	11.28	9.05	8.88	12
.05	.46	.05	.48	6.85	3.62	.01	.02	.02							13*
12.04	8.11	2.63	4.29	.16	.02	2.75	1.49	.06							14
1.49	.13	.02													15
.54	1.19	2.01	.82	.15	.04	.06	.06	.08							16*
.66	1.62	1.57	.60	.01		.01	.01	.01							17*
.19	.16	.16	.26	.13	.12	.60	.48	.39							18
.08	.04	.07	.32	.31	.06	.04									19*
2.15	2.40	2.48	.18	-.02	-.02	.03	.01	.01							20
.09	.08	.42	.51	.01											21
			.07	.08	.06	.12	.20	.20							22
			.96	.06	.01	.51	.46	.71							23
6.01	4.82	2.70	.74	.22	.07	.01	.03	.01							24*
.03	.01	.01	.17	.02	.01	.26									25*
.14	.19	.19	.88	.28	.28	3.38	.91	.28							26
1.34	1.58	1.71	.42	2.24	2.24	.22	1.27	1.27							27
.30	.19	.19	.04	.02	.02										28
.10	.21	.21	.01	.40	.21	.85	.94	.94							29
	.01	.01	.67	.01		.09									30
1.39	3.07	6.01	3.44	2.20	1.13	1.48	2.01	2.27							31
.02	.16	.16	.49	.36	.36	.17	.39	.39							32
.15	.17	.17	.03												33
.04	.07	.07	.52	.47	.02	.15	.01	.01							34
.09	.29	.29	.04	.01	.01	.10									35
.42	.47	.47	.06	.02	.02	.11	.03	.02							36
.71	1.38	2.20	.46	.34	.34	.01	.01	.01							37
6.34	4.26	2.86	1.60	1.08	.51	.03									38
			.04	.05	.46										39
.03	.09	.09	.18	.01	.01	.10									40
.04	.13	.12	.06	.28	.28	.07	.08	.03							41
.04	.50	.58	.29	.34	.34	-.03	.23	.24							42
.06	.03	.43	.78	.72	.51	.07	.03	.02							43
.42	.89	.39	.07	.02	.02	.18	.09	.08							44
.06			.34	.24	.34	1.36	.11	.02							45
	.07	.07	.13	.41	.41	.10	.28	.24							46
.03	.17	.17	.21	.63	.62	.17	.43	.09							47
.17	.16	.15	.07	.40	.40	.04	.16	.16							48
.05	.04	.04	.42	.61	.61	.35	.06	.02							49
	.08	.08	.11	.13	.12	.01	.18	.18							50
	.20	.20	.06	.23	.33	.38	.47	.47							51
	.02	.02	.11	.19	.19	.04	.12	.11							52
.02	.27	.27	1.58	.55	.17	.04	.03	.05							53
			.13	.04	.06	.05	.01	.01							54
	.06	.06	.46	.05	.06	.18	.04	.04							55
.02	.19	.19	1.86	4.23	6.31	.03	.32	.33							56*
	.01	.01	.47	.71	1.66										57*
	.18	.10	.52	.27	.11	.10	.17	.17							58
.08	2.98	2.98	1.99	.03	.61	2.44	2.80	1.82							59
.01	.27	.27	14.92	19.70	24.41	.01									60*
.13	.27	.27	9.65	1.98	.43	.08	.20	.30							61
.36	.32	.30	1.06	1.65	1.91	.40	.46	.33							62
.05	.36	.36	.60	.42	.23	.21	.03	.08							63
.09	1.17	1.27	.85	.11	.02	.02	.94	.94							64
-1.84	-.08	-.01	6.77	4.36	2.39	6.08	2.11	.73							65
			1.08	.51	.21	1.42	1.00	.61							66
															67
.04	.17	.17	.39	1.46	1.05	2.20	2.45	2.56							68
-3.76	-2.97	-2.25	.97	1.95	2.78	3.20	.06	.28							69
1.17	-.21	-.21	.43			1.34	1.00	.85							70
			8.46	.34	.96	2.06	1.22	.64							71
			2.44	.74	.21	2.22	.46	.11							72
			-1.68	1.40	1.49	.87	2.93	7.20							73
			3.49	16.60	20.78										74
			.17	.39	.38	.61	.44	.28							75
			.11	.06	.05	.47	-.28	-.28							76
			12.90	.25	.02	.77	1.09	2.07							77
			.57	.17	.40	.07	.25	.17							78
				.84	.34		.02	.09							79
45.20	48.64	45.84	9.54	3.24	6.45	.11	.02	.02							80
															81
				.22	.23		.69	.69							82
.60	1.39	1.39	-27.67	.35	.35	.43	1.80	1.80							83
									99.88	96.59	92.90	97.92	88.63	88.39	84
2.78	2.49	2.49	-.80	-.95	-.93										85
															86
100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	87

Source: U.S. Department of Commerce, Office of Business Economics.

when the I–O method was used. Although it is clear that the I–O method yielded better results than the blow-up method, the improvement should be considered in the light of the lower cost of the GNP blow-up method. Of course, the latter method does not allow for possible differences among industries in rates of output change.

Summary of Findings and Conclusions

The simplified I–O technique which has been described and tested in this report yielded long-range industry output projections that were not entirely satisfactory. The average error in five-year-ahead projections was close to 8 percent. Forty-five percent of the industries examined showed errors of more than 10 percent, although fewer than 10 percent of the industries had errors of more than 20 percent. While these results were superior to those obtained by the GNP blow-up technique, the higher cost of the I–O method should be taken into account.

In general, errors in projecting the GNP components were not an important source of error in the industry output projections. However, this may reflect the performance of the model in this particular instance and may not be characteristic of its general performance.

Errors in industry outputs were associated with the procedure of translating the GNP components into a bill of goods by use of 1958 bridge tables and with the use of the 1958 inverse matrix. The errors were reduced on the average by adjusting the bridge tables for trend and the intermediate outputs for the average impact of past coefficient changes. The remaining error could not be factored into its bridge table and coefficient components.

The results just summarized must be regarded primarily as a test of the ability of the method used in the article to make long-term industry output projections as of the year 1963, and not necessarily of its ability to make such projections today, or at some time in the future. For projections made as of today, I–O tables for 1961 and 1963 would be available, as well as those for 1947 and 1958. The additional information would provide a stronger basis than existed in 1963 for projecting trends in bridge tables and input coefficients.[19] Moreover, if annual I–O tables can be produced, the lapse of time between the last year for which an I–O table is available and the year for which a projection is made will be considerably shortened. This, too, would improve the accuracy of the procedures described in this report.

However, these improvements may not be sufficient. To improve the projections of industry outputs further, it may be necessary to strengthen the procedures used in this study. The ability of the model to project GNP components needs to be improved. This holds particularly for residential and nonresidential structures, imports, and State and local government purchases, if the 1968 results are characteristic of the model's general performance. These improvements, along with an improvement in the model's ability to project GNP from the supply side, can at the same time improve the estimate of Federal Government purchases which was derived as a residual, and was thus subject to the combined effect of all model errors.[20]

Disaggregation of the model to yield more detailed GNP components would facilitate the task of translating GNP components into a bill of goods. However, this would improve the industry output projections only if it were not offset by a deterioration in the ability of the model to forecast total GNP and its components.

The techniques for projecting bridge tables used in this study must also be improved. Projections based on causal analysis of past trends in bridge tables may have to be substituted for mechanical extrapolations of these trends. Moreover, not all differences among bridge tables should be regarded as trends, and an effort must be made to distinguish cyclical and random movements from longer run movements in these percentage distributions. Improvement in the projections of changes in input coefficients is also of considerable importance. To achieve this, it may be necessary to abandon the summary techniques used in this study and to face the complex task of projecting changes in individual coefficients.[21]

The needs for improvement outlined here call for continuing research. For purposes that require a high degree of precision, the additional expense and effort seem unavoidable.

APPENDIX Table 2.—Average Annual Rate of Change, 1947–58, in Intermediate Output Requirements of 1958 Final Demand, and Adjustment Factor Applied to 1958 Intermediate Output

I–O Industry*	Average annual rate of change, 1947–58 (Percent)	Adjustment factor applied to 1958 intermediate output
7	−5.5	0.585
12	−3.3	.723
13	−2.7	.766
19	2.4	1.226
21	−4.3	.597
23	−2.2	.804
27	3.1	1.357
28	5.9	1.774
29	3.3	1.402
37	−2.8	.759
41	−2.2	.804
50	6.6	1.896
51	16.2	4.116
53	2.6	1.290
54	5.6	1.724
56, 57	7.5	2.061
62	2.2	1.270
63	2.5	1.290

*Includes only industries with an average annual rate of change in intermediate output of 2 percent or more.

Source: U.S. Department of Commerce, Office of Business Economics.

19. The proposition that each additional table strengthens the projections was tested. When a 1963 bill of goods based on an analysis of trends in bridge tables for 1947, 1958, 1961, and 1963 was utilized, the industry output projections were somewhat improved. Similarly, the effectiveness of the adjustment for the impact of changes in input coefficients was improved when these adjustments were based on the 1947, 1958, and 1961 I–O tables. The 1963 I–O table could not be used for the coefficient adjustment because it is not yet available in 1958 prices.

20. The model was designed to serve as a tool for the formulation of fiscal policy. Because Federal Government purchases are an important policy instrument for achieving given unemployment targets, it is important to have an accurate basis for determining their desired level.

21. See the references in footnotes 6 and 11 to BLS work in these areas.

U. S. GOVERNMENT PRINTING OFFICE : 1971 O - 438-032